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Profiled Membrane

The invention relates to a profiled membrane, in particular for use as an insulation layer for walls of buildings, floors and roofs, to a composite panel comprising a base body and a profiled membrane disposed on the base body, to a process for manufacturing a profiled membrane with a surface having a degree of reflection of more than 0,2 (20% reflection), in particular more than 0,35 (35% reflection) or 0,5 (50% reflection) as well as to a process for thermally insulating a building, in particular for thermally insulating a floor.

Known profiled membranes of the type mentioned in the opening paragraph are normally used to protect the foundation wall, in which case they are provided between the ground and the exterior of the foundation wall or, respectively, an insulating body used there, fulfilling, in addition, a drainage function.

However, the profiled membranes currently used have no effect on the thermal insulation of the buildings, since their thermal transmission resistance is extremely low, in particular as a result of low reflection properties of the surfaces. Thus, currently used brown or black profiled membranes have a degree of reflection of merely 2-5%.

Known composite panels of the type mentioned in the opening paragraph are used as floor panels, preferably abroad, in which case they are used between heated living areas and an unheated basement, for example a concrete base of a cellar or a living area established at ground level.

In this context, the composition of the composite panel comprises, for example, a base body consisting of a chipboard panel or a plywood panel and a profiled membrane fitted to the base body. The profiled membrane serves in this case both as a vapour barrier against humidity, which might possibly rise up from the concrete base, as well as for a resilient mounting of the floor panel so that a certain damping effect is attained.

However, the use of such composite panels suffers from the drawback that, despite the cavities between the profiled membrane and the concrete base as well as in the profiles themselves, only unsatisfactory thermal insulation is attained. Known solutions to this problem provide the use of an additional insulating layer between the profiled membrane and the base body. This may well improve thermal insulation as a whole, but headroom will be lost due to the required thickness of the insulating layer, being particularly problematic when using such a composite panel in old buildings. Furthermore, the manufacture of such composite panels comprising an insulating layer proves to be very complex and last, but not least, extremely expensive because of the additionally required insulating material.

It is, therefore, the object of the invention to provide a profiled membrane having a high resistance to heat transmission as well as to improve the thermal insulation of a composite panel of the type mentioned in the opening paragraph while retaining the fundamental structure of known composite panels. It is further the object of the invention to provide a process for the production of a profiled membrane reflecting infrared radiation as well as a process for thermally insulating a building, in particular for thermally insulating a floor.

The invention attains the object by a profiled membrane according to the characteristics of claim 1, by a composite panel according to claim 8 as well as by a process according to claims 12 and 13. Advantageous further developments of the invention are described in the dependent claims.

The profiled membrane according to the invention is characterised by a surface, which has a high degree of reflection. A high degree of reflection, within the scope of the invention, means in this context a reflection of the surface of more than 20%. The profiled membrane may in this case, in principle, comprise moulded hollow profiles on one side or on both sides of a plane, in which context

profiled membranes with profiles formed on one side are preferred for manufacturing the composite panel according to the invention. The profiled membrane is in this context fitted to a base body by its side facing away from the profiles.

The total thermal transmission resistance of the profiled membrane as well as of the composite panel is the combination of the thermal transmission resistance to radial heat and the thermal transmission resistance to convection heat. The total thermal transmission resistance is mathematically calculated from the reciprocal value of the sum of the thermal transmission resistance values to convection and radial heat. Due to the high degree of reflection of the surface of the profiled membrane, the thermal transmission resistance to radial heat and, as a result, the total thermal transmission resistance, may be influenced.

The broad field of application of the profiled membrane according to the invention, for example for installing a floor, for sealing walls of buildings in the ground or above ground or for insulating the roof area, permits in this context to provide the buildings with particularly high thermal insulation as a whole, which contributes to a clear reduction in heating costs.

In order that the high degree of reflection of the surface of the profiled membrane considerably improves its thermal transmission resistance to radial heat, it is necessary for air layers to adjoin the surface of the profiled membrane. Using the profiled membrane according to the invention for assembling the composite panel ensures the existence of sufficient air layers, where applicable on the surface of the profiled membrane, according to the distribution of profiles and free surface areas.

In the case of the preferred use of a profiled membrane comprising profiles, moulded thereon on one side, air layers border on large portions of the profiled membrane in a position of use of the composite panel, for example when used as

a floor panel. Thus, an air layer is present between the cavities of the profiles formed between the profiled membrane and the base body. A further labyrinth-like contiguous air layer is present between the profiles. These extensive regions ensure that the total thermal transmission resistance of the composite panel is increased substantially by the high degree of reflection of the profiled membrane.

According to an advantageous further development of the invention, the surface of the profiled membrane has a degree of reflection higher than 0,2 (20% reflection), in particular higher than 0,35 (35% reflection) or 0,5 (50% reflection). At a degree of reflection as low as 0,2, the thermal transmission resistance of the profiled membrane in comparison with dark profiled membranes having a degree of reflection of 0,02 to 0,05, is higher at least by the factor 1,2. At a degree of reflection of 0,35 or 0,5 the thermal transmission resistance of the composite panel corresponds to more or less 1,4 times or 1,7 times respectively, the value of dark profiled membranes. This ensures, therefore, that high thermal insulation is attained or that the insulating performance is increased without using additional insulating materials.

In principle, the profiled membrane may be produced in any desired manner and may be designed to have a high degree of reflection. According to a further development of the invention, the profiled membrane is, however, formed of plastics, in particular pigmented plastics, reflecting infrared radiation. Such a profiled membrane made of plastics is characterised, in particular, by its simple and cost-effective production as well as its formability and flexibility. These properties further permit a particularly favourably priced and unproblematic production of a composite panel.

According to a further embodiment of the invention, the profiled membrane presents a smooth surface. Such a configuration of the surface structure of the profiled membrane increases the degree of reflection in a complementary manner, attaining an additional increase of the thermal transmission resistance

to radial heat, so that the total thermal transmission resistance of the composite panel is further enhanced.

The possibilities to design the profiled membrane with a high degree of reflection, are very diverse. According to a further development of the invention, the surface of the profiled membrane comprises a reflective coating. Depending on the type of coating, the latter may be applied to the surface of the profiled membrane, in a mechanical manner, by vacuum-metallisation or in any other manner.

The coating may furthermore be so designed that it is suitable to reflect or at least absorb electro-magnetic radiation. The attenuation amounts in this context to at least 5 dB, preferably at least 10 dB, particularly preferably at least 15 dB. Due to this design of the profiled membrane according to the invention, its field of application is enhanced in a complementary manner, taking into account the increasing significance of shielding living and working space from undesirable electromagnetic radiation.

The coating may, for example, be brought about by applying to the surface of the profiled membrane a pigment-containing liquid, the pigments remaining on the surface of the profiled membrane after the liquid has drained off, conferring to the said profiled membrane its reflective properties.

When using plastics for producing the profiled membrane, the coating may also be generated by a separate foil, which is fed towards the profiled membrane made of plastics immediately after extrusion, and may subsequently likewise be subjected to the moulding process of the profiles. The use of a metal-coated foil, by means of which a degree of reflection of the profiled membrane of 50-80% may be attained, has proved to be particularly advantageous in this context.

Coating of the surface of the profiled membrane according to this further development of the invention permits the use of any desired profiled membranes for manufacturing the composite panel. The degree of reflection may be freely selected by correspondingly choosing the coating, regardless of the material of the respective profiled membrane.

According to a further embodiment of the invention, the plastics contains colour pigments, in particular titanium dioxide or metal pigments, for example aluminium pigments. In this embodiment of the invention, the pigments may already be mixed into a corresponding plastics molten mass prior to the extrusion of the profiled membrane, so that a post-treatment of the profiled membrane after extrusion in order to increase the degree of reflection, may be dispensed with. The titanium oxide, but in particular the metal pigments, for example the aluminium pigments, are characterised in this context by their property of permitting a profiled membrane having a high degree of reflection to be formed even when present in low concentrations in the plastics melt. The positive properties of the profiled membrane made of plastics, such as flexibility, impact resistance, stability etc., are in this context not negatively affected by the titanium oxide.

According to a further embodiment of the profiled membrane, the surface of the profiled membrane is coated with metal. The metal coating may, for example, be applied by vacuum-metallisation or be applied to the surface of the profiled membrane mechanically in the form of a foil. The metal coating which may, for example, be produced by using aluminium or chromium, makes it possible to increase the degree of reflection of the profiled membrane up to 95%.

The profiled membrane according to the invention may, in principle, be used on its own, for example for thermal insulation in the floor, roof or wall region. Moreover, the profiled membrane may also be combined with other materials or building materials, such as sealers or thermal insulators, in which context the

manufacture of a correspondingly prefabricated product is also possible, which will then offer the advantages of the profiled membrane according to the invention and of the further product(s).

When using the profiled membrane for producing the composite body, the base body may be freely selected according to the field of application of the composite panel. According to an advantageous further development of the invention, the base body is in the form of a chipboard panel or a plywood panel.

Chipboard and plywood panels are characterised, *inter alia*, by their cost-effective production, their simple processing as well as by their particularly favourable insulating properties, so that the corresponding properties of the composite panel according to the invention may be further improved. The further development of the invention further permits a particularly cost-effective production of the composite panel according to the invention.

Apart from using chipboard or plywood panels to serve as the base body, known thermal insulators, such as, for example, mineral fibre panels, may be used to manufacture a composite panel. These may also be used in the roof region or for insulating the walls of the buildings.

According to a further embodiment of the composite panel, a metal foil or vapour-metallised plastic foil is provided on the side of the base body facing the profiled membrane or between the profiled membrane and the base body. This particularly simple further development improves the thermal transmission resistance of the composite body in a complementary manner.

According to a further development of the composite panel, the base body includes two pairs of parallel edges, two neighbouring edges being provided with coupling elements in the form of a groove and the other two being provided with a tongue, fitting into the groove. This further development offers the advantage

that the installation of the composite panel is facilitated and the composite panels used may be interconnected among one another in a form-fitting manner, resulting in enhanced stability of the assembly formed by a plurality of composite panels.

The feeding of a metal-coated, in particular metallised foil, e.g. aluminium on an LDPE-foil, after the extrusion of a membrane made of plastics, is an important feature of the process of producing a profiled membrane reflecting infrared radiation, in which case in the subsequent forming process during which the profiles are formed, the metal-coated, in particular vapour-metallised foil adhering to the membrane made of plastics, is also deformed therewith, so that a particularly stable connection between this foil and the membrane made of plastics is brought about.

It is a characterising feature of the process according to the invention for thermally insulating a building, in particular for thermally insulating a floor, that first a profiled membrane having a degree of reflection of more than 0,2 (20% reflection), in particular more than 0,35 (35% reflection) or 0,5 (50% reflection) is arranged on the surface to be insulated, in particular the floor, and that thereafter a base body is applied to the profiled membrane.

This process permits in a particularly simple manner to bring about thermal insulation on the spot, for example directly at the building site. The placement of the profiled membrane is in this context performed in a particularly simple manner, due to its flexibility and good processability.

When using a profiled membrane made of plastics, the latter, usually present in the rolled-up state, must merely be unrolled on the surface to be insulated in order to bring about thermal insulation. The base body is subsequently fitted to the profiled membrane.

An embodiment of the invention is elucidated in the following with reference to the drawing. There is shown in:

Fig. 1 a section through a composite panel arranged on a concrete base.

Fig. 1 shows a profiled membrane 3 and a base body 2, which, together, form a composite panel 1, illustrated in the position of installation as a floor panel on a concrete base 5. The composite panel 1 consists of a double-layered structure composed of the profiled membrane 3 and the base body 2.

The profiled membrane 3 consists of plastics and comprises diagonally extending profiles 4, formed on one side, with end faces 6 extending essentially parallel to the plane of the profiled membrane, the said end faces being in contact with the concrete base 5. In the position of installation of the composite panel 1, extensive air layers border onto the profiled membrane 3 on either side of the profiled membrane 3. By way of its side facing away from the profiles 4, the profiled membrane 3 is adhesively bonded to an underside 7 of the base body 2. An upper side 8 of the base body 2 forms a walk-on side of the composite panel 1.

For attaining high thermal transmission resistance of the composite panel 1, the plastics of the profiled membrane 3 has a degree of reflection of 0,2 (20% reflection). The base body 2 consists of a chipboard panel.

A coating, not shown here, of the profiled membrane by means of a varnish containing metal pigments brings about the shielding from electromagnetic radiation of 17 dB in the range of 200 kHz to 10 GHz.

In what follows, two processes for the manufacture of a profiled membrane provided with an infrared radiation reflecting surface, are illustrated by way of example.

The manufacture may be realised by extrusion and continuous vacuum-deep-drawing of 97% HDPE (e.g. Stamyland HD 7625 of the firm Stamyland Deutschland) with a 3% aluminium pigment concentrate (e.g. Mastersafe 10203 of the firm Eckhart), so that a weight per surface area of 600 g/m^2 is attained. The degree of reflection of a profiled membrane manufactured in this manner, measured in the infrared range of $2\text{-}20 \text{ }\mu\text{m}$ by means of an Ulbricht globe, is 22%.

Manufacture may, for example, also be performed in that, in addition to the above mentioned process, a 15 g/m^2 LDPE foil, previously metallised with a $100 \text{ }\mu\text{m}$ aluminium coating is fed in such a manner during extrusion that the metallised side faces the molten mass. The foil becomes soft and is deep-drawn without destroying the aluminium coating too severely.

The degree of reflection of a profiled membrane manufactured in this manner, measured in the infrared region of $2\text{-}20 \text{ }\mu\text{m}$ by means of an Ulbricht globe is 22% on the side without a metal foil and 45% on the side with the metallised foil.